State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

DIABLO CANYON POWER PLANT SITE

ECOLOGICAL STUDY

QUARTERLY REPORT NO. 9

JULY 1 - SEPTEMBER 30, 1975

by

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Laurence L. Laurent and
Fred E. Wendell

PACIFIC GAS AND ELECTRIC COMPANY
COOPERATIVE RESEARCH AGREEMENT 5-11-75

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ABSTRACT

During the Quarter we surveyed seven permanent and 48 random subtidal stations. In addition a new study was undertaken with the surveying of one random subtidal station in Diablo Cove where counts were made of small invertebrates within four ¼-m quadrats. Red abalone, *Haliotis rufescens*, numbers continued to decrease at random as well as permanent stations in Diablo Cove. Bull kelp, *Nereocystis luetkeana*, more than doubled in density in Diablo Cove. Permanent stations showed a decline in giant red sea urchin, *Strongylocentrotus franciscanus*, numbers while random stations indicated an increase in abundance.

The commercial sea urchin fishery was inactive. Commercial abalone fishermen were observed infrequently in the Pecho Rock area.

1/ Marine Resources Administrative Report No. 76-1, January 1976.

2/ Operations Research Branch, 2201 Garden Road, Monterey, California 93040.

This is the ninth quarterly report submitted in partial fulfillment of Research Contract N. 5-11-75 between the Department of Fish and Game and the Pacific Gas and Electric Company. Through this contract, the Department of Fish and Game is to conduct ecological monitoring studies to determine what changes have occured since the 1970-71 base line inventory of the marine biota, with special reference to fish and abalone.

Quarterly reports will be followed by annual reports. Full tables and species lists will be included in each annual report.

Submitted to:

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INTRODUCTION

The entire quarter was devoted to completing surveys of random and permanent subtidal stations and continuing the catch-per-unit of effort study of sport fish. In addition we initiated a random survey of "micro" subtidal communities. The commercial sea urchin fishery was inactive while the commercial abalone fishery continued at low ebb.

In July biologists Laurent and Wendell were transferred to the San Luis Obispo area to increase our collection of field data and to be in closer contact with any changes in and around Diablo Cove. Laboratory and office facilities are being constructed by PG&E near Intake Cove.

OPERATIONS

Permanent Subtidal Station Surveys

We surveyed seven of the nine permanent stations during July and August. All of the stations except 16 are the same stations established during the 1970-71 studies (Figure 1). Stations 8 and 10 could not be located.

The stations yielded increased abundance over last summer's count for *Laminaria, Pterygophora, Cancer antennarius,* and *Haliotis kamtschatkana* at Control Stations as well as those in Diablo Cove (Table 1). Giant red sea urchins, *Strongylocentrotus franciscanus;* bat stars, *Patiria miniata;* and *Astraea gibberosa* decreased in numbers. Bull kelp, *Nereocystis luetkeana,* increased in Diablo Cove but decreased at the Control Stations. Red abalone, *Haliotis rufescens,* were not present at any of the permanent Diablo Cove stations surveyed this summer.

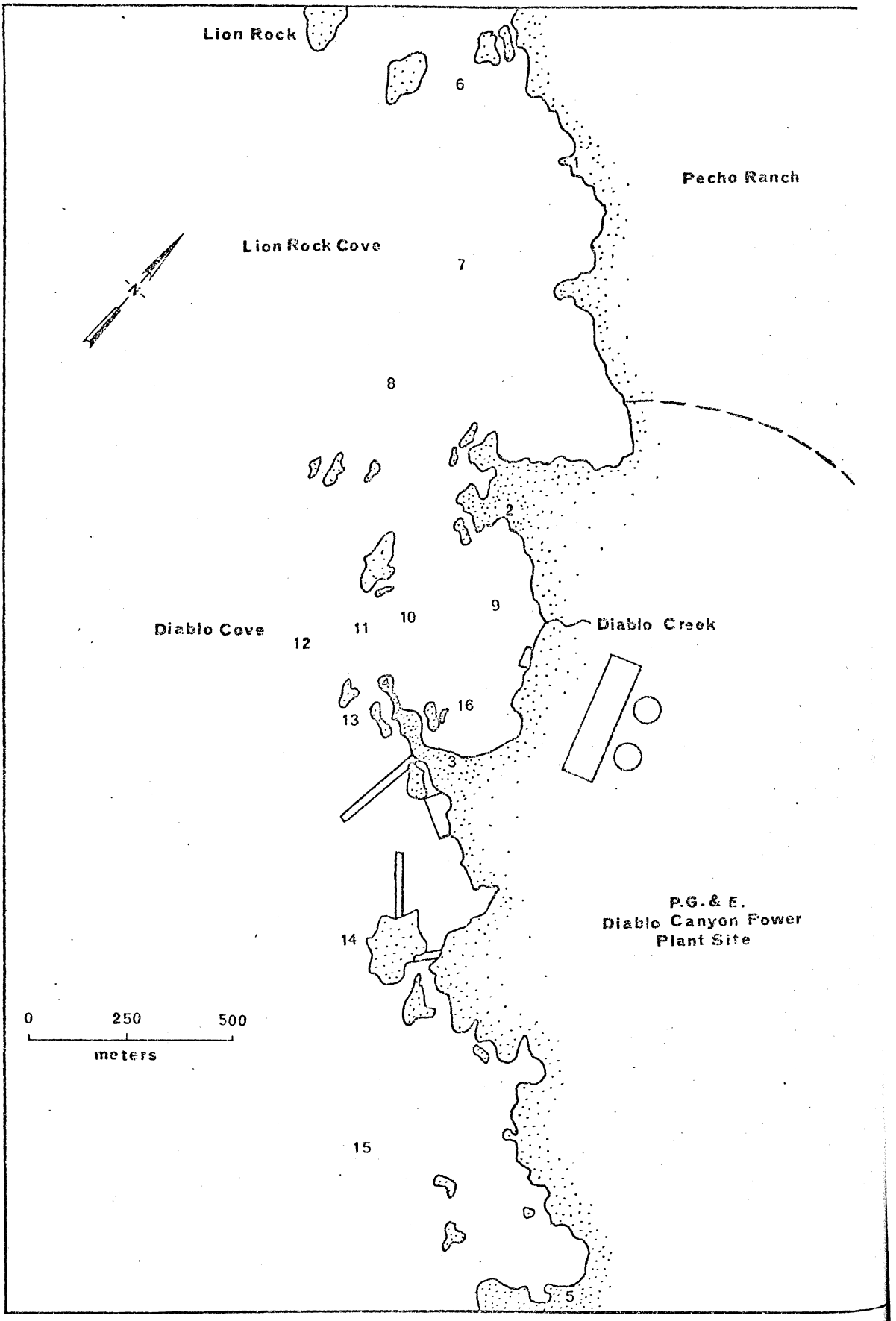

FIGURE 1. Location of permanent subtidal and intertidal stations - Diablo Canyon power plant site.

TABLE 1 Comparison of Mean Counts per m^2 of Three Species of Brown Algae and Seven Species of Invertebrates at Permanent Subtidal Stations - Diablo Canyon Power Plant Site - July through September 1974 and July through September 1975.

SPECIES	Diablo Cove		Control	
	1974	1975	1974	1975
Laminaria dentigera	0.62	1.07	0.58	0.86
Nereocystis leutkeana	0.74	1.79	0.83	0.30
Pterygophora californica	1.23	1.96	0.79	2.70
Astraea gibberosa	0.16	0.09	0.03	0.01
Cancer antennarius	0.00	0.02	0.004	0.01
Dendrodoris fulva	0.06	0.06	0.14	0.23
Haliotis kamtschatkana	0.003	0.01	0.00	0.01
Haliotis rufescens	0.04	0.00	0.01	0.01
Patiria miniata	3.14	2.08	2.62	1.77
Strongylocentrotus franciscanus	1.23	0.62	3.02	2.48
TOTAL STATIONS	5	4	4	3

Random Subtidal Station Surveys

All of the 48 random stations selected for 1975 were surveyed during the quarter. The 24 stations in Diablo Cove were stratified this year into four components: eight stations each were selected from the shallow South and North Cove respectively, approximate depths less than 7.6 m (25 ft); and four stations each from the deep portions of South and North Cove respectively, approximate depth range 7.6 to 18.3 m (25 to 60 ft) (Figure 2). Stratification for the 24 stations surveyed in the North Control Area remained the same as last year, i.e. 12 stations in the 3.0 to 6.1 m (10 to 20 ft) depth range, eight stations in the 6.4 to 12.2 m (21 to 40 ft) depth range and four stations in the 12.5 to 18.3 m (41 to 60 ft) depth range.

In addition, we began surveys at the random stations in Diablo Cove to quantify the smaller numbers of the benthic community (animals approximately 5 to 10 mm in diameter). Instead of using the 30 m^2 arc, we select four random points along a 30 m (100 ft) line layed parallel to shore; at each point we place a ¼ m^2 frame and count all of the invertebrates. Unidentified animals are collected for identification in the laboratory. We also count all *Nereocystis* stipes within 1 m (3.3 ft) on either side of the line. These counts will be used to complement our random station data in calculating the 1975 standing crop of bull kelp.

Analysis of the 30 m^2 arc data indicate the 24 stations in Diablo Cove and the North Control yielded means per m^2 with 95% confidence intervals equal to or less than one-half the mean for many of the important species (Table 2). For these species, we will be able to test statistically for significance if changes in abundance occur when the plant begins operating.

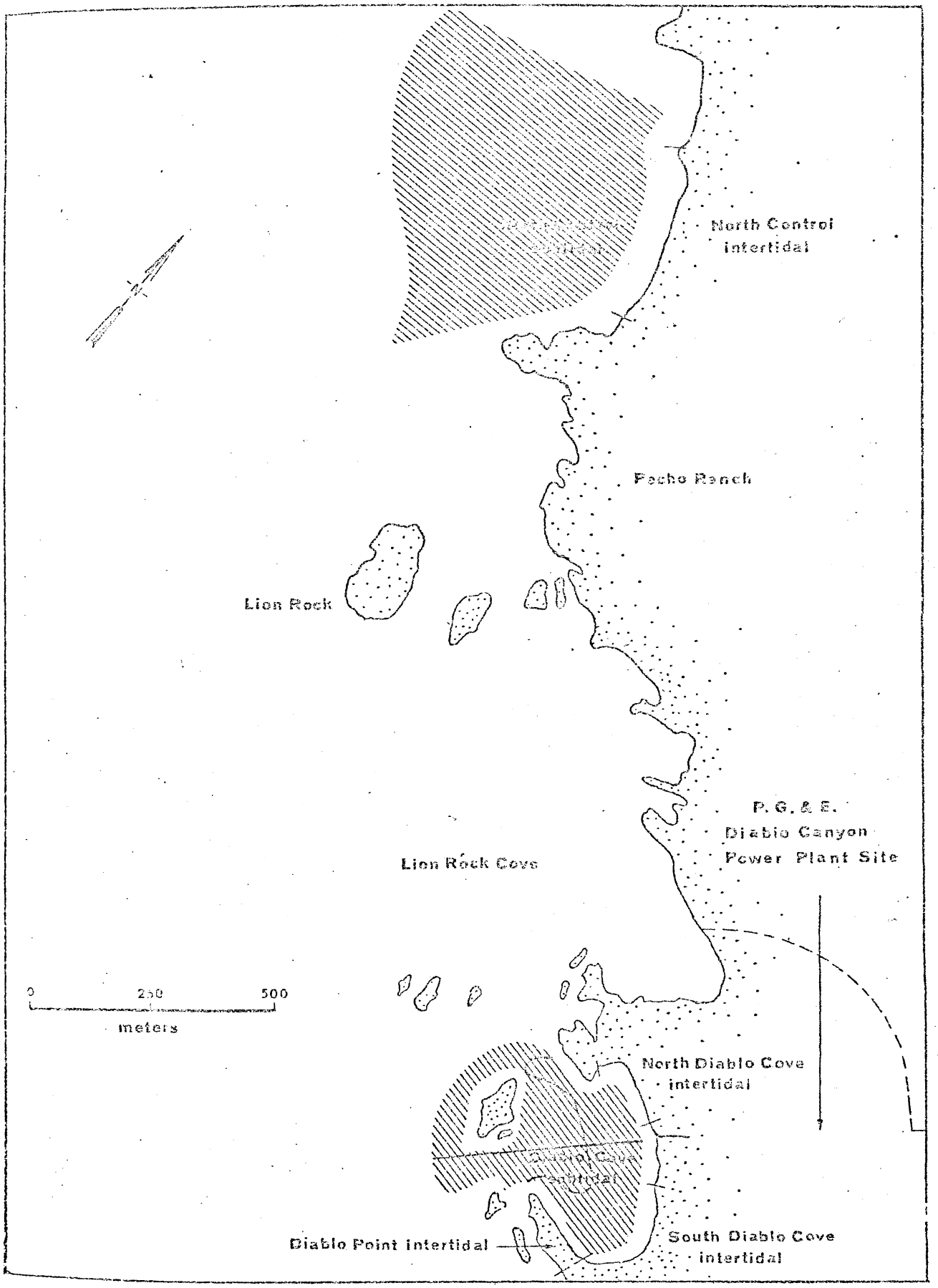

FIGURE 2. Location of random subtidal and intertidal areas -Diablo Canyon power plant site.

TABLE 2 Numbers, Percent Frequency of Occurrence, and 95 Percent Confidence Intervals for Three Species of Brown Algae and 12 Species of Invertebrates Random Subtidal Station - Diablo Canyon Power Plant Site - July through September 1975.

SPECIES	Diablo Cove Sum	Percent frequency	Mean Number per/m^2	95% Confidence interval	Control Sum	Percent	Mean	95%
Laminaria dentigera	2266	100.0	3.15	± 1.01	229	66.7	0.32	± 0.20
Nereocystis leutkeana	2086	95.8	2.23	± 1.00	91	29.2	0.13	± 0.10
Pterygophora californica	3144	95.8	4.37	± 1.88	375	54.2	0.52	± 0.38
Anthopleura xanthogrammica	231	87.5	0.32	± 0.22	214	79.2	0.30	± 0.16
Astraea gibberosa	139	95.8	0.19	± 0.08	245	91.7	0.34	± 0.17
Cancer antennarius	13	50.0	0.02	± 0.01	6	20.8	0.01	± 0.01
Dendrodoris fulva	106	79.2	0.15	± 0.07	116	75.0	0.16	± 0.07
Henricia leviuscula	55	50.0	0.08	± 0.06	79	83.3	0.11	± 0.04
Mitra idae	13	25.0	0.02	± 0.02	28	41.7	0.04	± 0.03
Orthasterias koehleri	25	41.7	0.03	± 0.03	13	29.2	0.02	± 0.02
Patiria miniata	2167	100.0	3.01	± 0.93	1409	100.0	1.96	± 0.67
Pisaster giganeus	46	54.2	0.06	± 0.05	49	66.7	0.07	± 0.05
Pycnopodia helianthoides	45	70.8	0.06	± 0.03	40	83.3	0.06	± 0.03
Strongylocentrotus franciscanus	411	58.3	0.57	± 0.44	106	70.8	0.15	± 0.09
Tethya aurantia	91	58.3	0.13	± 0.11	127	79.2	0.18	± 0.07
TOTAL STATIONS	24				24			

It is worthwhile to note that red abalone were observed at only one station in Diablo Cove, a station in South Cove in 2.1 to 3.0 m (7 to 10 ft) depth, and at four stations in the North Control; a decline from last summer's counts when red abalone occurred at 2 out of 14 stations in Diablo Cove and 5 out of 14 stations in the North Control.

Bull kelp counts increased substantially over last year's counts in Diablo Cove, jumping from 1.14 to 2.23 per m^2, probably due to the decline of herbivores in Diablo Cove. However, counts declined in the North Control, from 0.34 to 0.13 per m^2. Giant red sea urchin counts also increased in Diablo Cove and in North Control, from 0.11 to 0.57 per m^2 and 0.03 to 0.15 per m^2 respectively. These data contradict those collected at the permanent stations; however, we believe that because they are selected from all the areas within the Cove, random station counts are more representative than those from the permanent stations. Increased counts are possibly due to a lack of sea otter, *Enhydra lutris*, predation since last fall (see sea otter section) and recruitment.

Intertidal

Intertidal surveys of our study areas for the 1975 upwelling period were completed in June. Hence, no intertidal sampling was done during this quarter. Instead, field work consisted entirely of subtidal surveys. Other activity at Diablo Cove was largely composed of working up the intertidal algae samples from the upwelling period and working on the data for the annual report.

Commercial Fisheries

The commercial sea urchin fishery was inactive and the commercial abalone fishery operated at low ebb; only two or three boats have been observed fishing around Pecho Rock.

Sea Otter Counts

Observed sea otter activity countinued to center around Point Buchon and Coon Creek. However, individuals occasionally were observed as far south as Pecho Rock. Mean weekly sea otter counts varied only slightly each month (Table 3), the average count for the quarter was 54 ± 10 individuals. On August 21, 1975, a female sea otter and pup were observed south of Coon Creek, the first such observation in this area.

TABLE 3 Monthly Mean Counts of Sea Otters and Observed Feeding Habits - Coon Creek to Pecho Rock - July 1975 through September 1975.

Date	Mean count	Range	Standard deviation	Number of counts	Number Observed Feeding		
					Abalone	Urchin	Unident.
July 1975	46	32-57	11	4	1	0	2
August 1975	51	35-64	12	4	1	0	3
September 1975	55	51-58	3	4	1	0	3

Catch-Per-Unit-of-Effort of Sportfishes Study

The large canopy of bull kelp in Diablo Cove prevented us from sampling at most stations; however, six stations yielded a catch rate of 2.89 fish per hour, a substantial increase over the period April through June when eight stations yielded 0.5 fish per hour. The North Control Stations produced 2.70 fish per hour (21 stations). Three stations

occupied between April and June 1975 produced 6.0 fish per hour. For the first time black rockfish, *Sebastes melanops*, were the dominant species caught in Diablo Cove; Blue rockfish, *S. mystinus*, was the most numerous species in North Control Area catches.

APPENDIX I

MAN-DAYS SPENT AT DIABLO CANYON POWER PLANT SITE

July 1 - September 30, 1975

Subtidal surveys:	July 7 - 12
Participants:	Gotshall, Laurent, Wendell, Chea
	July 14 - 18
Participants:	Laurent, Wendell, Cheap
	July 21 - 26
Participants:	Gotshall, Wendell, Cheap
	July 28 - August 1
Participants:	Laurent, Wendell, Cheap
	August 4 - 8
Participants:	Gotshall, Wendell, Cheap
	August 11 - 15
Participants:	Laurent, Wendell, Cheap
	August 25 - 29
Participants:	Laurent, Wendell, Cheap
	September 1 - 5
Participants:	Laurent, Wendell
	September 8 - 12
Participants:	Gotshall, Wendell, Laurent
	September 15 - 19
Participants:	Laurent, Wendell
	September 22 - 26
Participants:	Laurent, Wendell
	September 29 - October 3
Participants:	Laurent, Wendell, Cheap

Total man-days during quarter	252
Total man-days at site	169
Boat-days lost to weather	2
Total stations surveyed	85
Travel time man-days	5
Boat time (hours)	30.4
Laboratory time man-days	78

PROJECT PERSONNEL:

Daniel W. Gotshall	Senior Marine Biologist, Project Leader
Laurence L. Laurent	Associate Marine Biologist
Fred E. Wendell	Assistant Marine Biologist
Lois E. Sloan	Stenographer
Kathleen M. Cheap	Seasonal Aid
Jane E. Dykzeul	Seasonal Aid